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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/627,418	07/27/2000	Tatsuya Usami	00N010-US	1182

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EXAMINER

QUACH, TUAN N

ART UNIT PAPER NUMBER

2814

DATE MAILED: 03/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/627,418

Applicant(s)

USAMI, TATSUYA

Examiner

Tuan Quach

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on December 23, 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,2,4,5 and 14-27 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 14 is/are allowed.
- 6) ☒ Claim(s) 1,2,4,5 and 15-26 is/are rejected.
- 7) ☒ Claim(s) 27 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 July 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### DETAILED ACTION

Applicant elects species 1 and adds new claims 25-27. Note that the claims clearly correspond to at least two different species as shown in the two embodiments, Figs. 6A- 7, and Figs. 8A-9 which are mutually exclusive in terms of combination of materials and that patentability of one does not imply that of the other. While it is incorrect that the number of species must be the same as the number of embodiments which is set by applicant, in view of the newly presented independent claim and the closely related features between new claim 27 and claim 14, pending claims 1, 2, 4, 5 and 14-27 will be considered together.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 2, 4, 5, 15-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin, Zhao, and Aoki, taken together.

Regarding claims 1, 2, 4, 5, Lopatin teaches copper 24 and low dielectric constant layer, e.g., layer 30 including HSQ material thus possessing the property that Cu is unlikely to enter since it is the same material employed consistent with applicant's acknowledgment on page 12 lines 1-2 that it is obvious that HSQ has properties of preventing diffusion of Cu. The provision of via in low dielectric constant 50 followed by barrier 54 and copper 58 is also taught. See column 6 line 4 to column 7 line 21. Although Lopatin does not explicitly recite the Cu concentration to be equal to or higher

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than  $10^{19}$  atoms/cm<sup>3</sup>, such would have been encompassed in Lopatin since the concentration is Lopatin is not required nor limited to be below said value, and since the optimization of such concentration to obtain a desired conductivity would have been obvious to one skilled in the art. Lopatin also shows that the barrier would act as the adhesion layer since it is located between the wiring lines and the insulating layer and not forbidding the adhesion therebetween. Lopatin does not recite the adhesion language, the use of tungsten, and the etching rate and polishing rate of the adhesion layer to be essentially equal to those of the wiring lines. The use of desired interlayer insulating materials including those contemplated by the instant application and its conjunctive use with copper further is evidenced by Zhao, column 6 lines 10 –19 wherein low dielectric constants can be obtained and as Zhao teaches the conventional use of liner in conjunction with copper wherein the barrier also provides adhesion, including the use of tungsten for such material. See column 4 line 52 to column 6 lines 25-63. The provision of openings 24 and 25 in various low dielectric constant material, e.g., layer 14, followed by copper conductor, e.g., 29, including barrier/adhesion is also shown. See column 6 line 10 to column 8 line 45. It would have been obvious to one skilled in the art at the time the invention was made in practicing the above invention to have included the barrier/adhesion in question to improve adhesion/barrier characteristic in the copper interconnect including the use of tungsten for such material. The selection of same etching rate would have been obvious and would have been within the purview of one skilled in the art to facilitate the removal of the wiring line and the adhesion/barrier layer. See additionally Aoki, column 8 lines 1-54 wherein the use

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of multilayer dielectric for multilevel metallization is delineated including evidencing that HSQ corresponds to well known low-k dielectric material which is advantageously formed to reduce a capacitance of a capacitor existing between the wiring lines as delineated in Aoki, column 8 line 36-38; and wherein alternative materials can be employed, including MSQ, FLARE or poly aryl ether film, etc., column 12 lines 31-57, column 8 lines 27-54. Note additionally the conjunctive use with copper, column 10 lines 45-46. Although Aoki does not explicitly recite the Cu concentration to be equal to or higher than  $10^{19}$  atoms/cm<sup>3</sup>, such would have been encompassed in Aoki since the concentration is Aoki is not required nor limited to be below said value, and since the optimization of such concentration to obtain a desired conductivity would have been obvious to one skilled in the art. Regarding claims 15-26 which corresponds to composite interlevel insulating layers, the multilayer including those claims using functional language e.g., the low permittivity layer and offsetting in strength would have been obtained from the layers taught in the prior art, when the composite interlevel dielectric layer is employed and as shown in Aoki, including composite layers of SiN 103, HSQ 105 and SiN 106, column 8 lines 13-61, wherein the copper migration would be obviated as delineated above and the functional recitation corresponding to permittivity and offsetting in strength would be obtained and as the same materials are employed. The repetition to form an additional interlayer insulating level including the inclusion of appropriate adhesion/barrier therein as in claims 18, 19, 22, and 23 would have been conventional to one skilled in the art to achieve the number of levels required

and wherein adhesion and barrier including tungsten can be achieved in each level and as shown in Zhao above.

Claim 14 is allowed.

Claim 27 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The limitations in these claims regarding the combination of the materials in question and in relating to the copper as delineated do not appear to be explicitly taught or suggested by the prior art of record.

Applicant's arguments with respect to claims 1, 2, 4, 5, 15-26 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number (571)272-1717. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (571)272-1705. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571)272-1562.



Tuan Quach  
Primary Examiner